Neutral pion production with respect to reaction plane at $\sqrt{s_{NN}}$=200 GeV Au+Au collisions at RHIC-PHENIX

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Motivation

Property of the produced medium in Au+Au collisions

What is the origin of jet quenching?

- It is considered to be Eloss due to soft gluon bremsstrahlung.

How dense is the medium?

- We can learn about it by studying **parton energy loss**

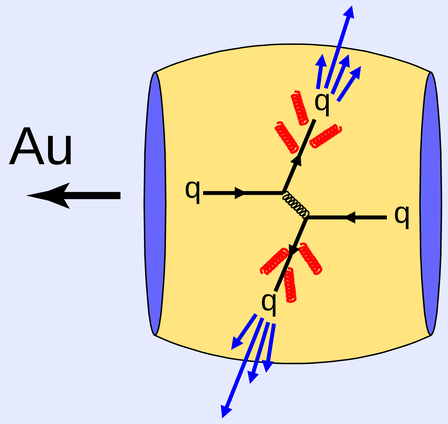
Can we verify a gluon coherence effect to the analogy of LPM in QED?

- Study path length dependence of radiative energy loss
- Prediction for the radiative E_{loss} model (for example in the GLV model)

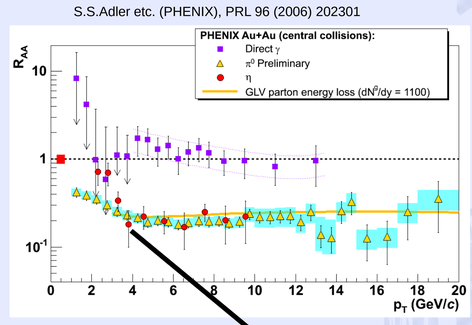
$$\Delta E = \frac{9\pi C_R \alpha_s^3}{4}\int_0^L d\tau\ \rho_{eff}(\tau, x(\tau))\ \tau \ln\left(\frac{1}{x_c}\right) \quad \text{(Static medium case)}$$

$$x_c = \frac{\mu^2 L}{2E}$$

$$E_{loss} \propto L^2$$

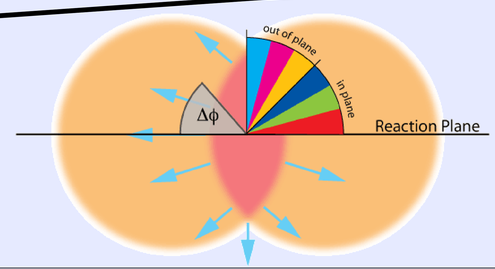


Schematic of parton energy loss



How do we extract RAA with respect to path length (L)?

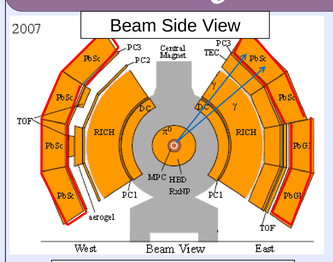
- R_{AA} measured at different angles with respect to the reaction plane
  $R_{AA}(p_T, \text{centrality}, \Delta\phi)$



$$R_{AA}(\Delta\phi, p_T) = \frac{N(\Delta\phi_i, p_T)}{\sum_{i=1}^{6} N(\Delta\phi_i, p_T)} \times R_{AA}(p_T)$$

$$N(\Delta\phi_i, p_T) \propto 1 + 2v_2\cos(\Delta\phi) + \ldots$$

Analysis status & New Results



Photon measurement

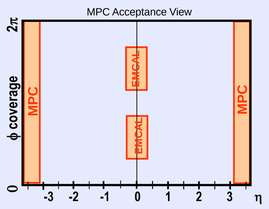
- 2 Arms × 4 Sectors
  6 Sectors Lead-Scintillator Calorimeter
  2 Sectors Lead-Glass Calorimeter
- Performance of electromagnetic Calorimeters in PHENIX

Energy Resolution

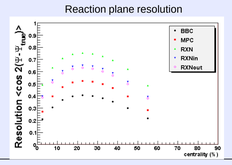
PbSc $\frac{8.1\%}{\sqrt{E(GeV)}} \oplus 2.1\%$ PbGl $\frac{5.9\%}{\sqrt{E(GeV)}} \oplus 0.8\%$

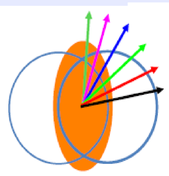
Reaction Plane measurement

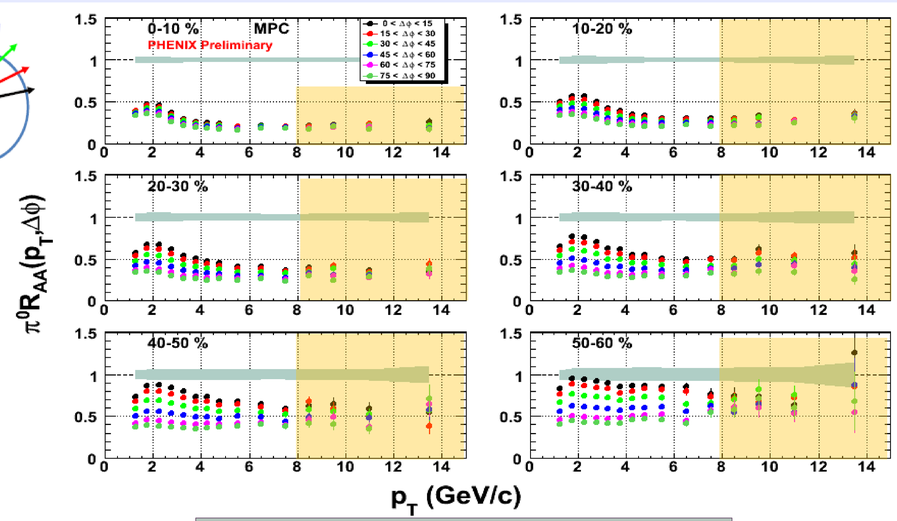
- Muon Piston Calorimeter (MPC)
  Rapidity 3.1 < |η| < 3.7
  PbWO4 Crystals + Avalanche Photodiodes



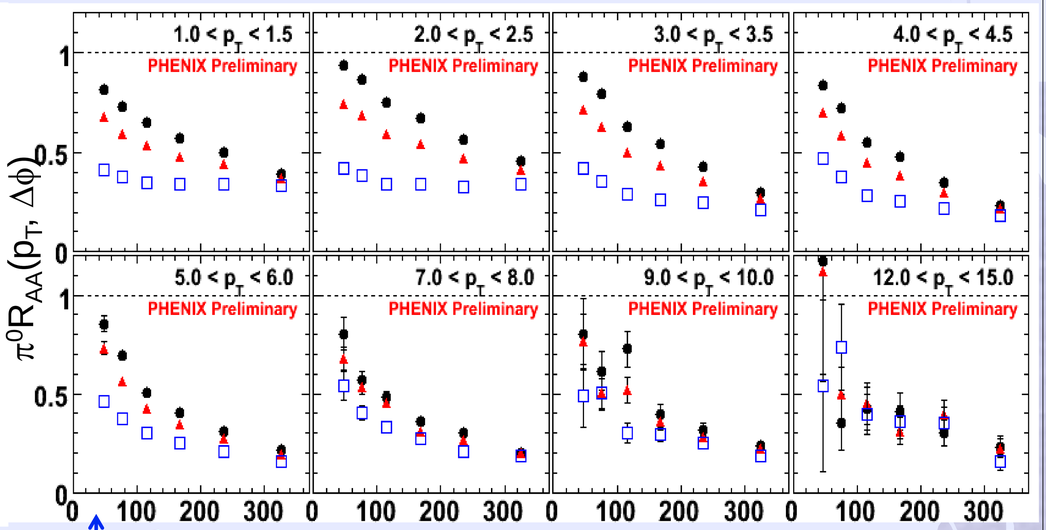
Reaction plane resolution

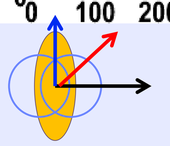






Band : Systematic error





- At low p_T
  Azimuthal angle dependence of R_{AA} can be clearly seen except for the most central collisions
- At high p_T
  Its dependence seems to be smaller

- **Out-of plane R_{AA} is nearly flat** with centrality at low p_T
- In- and out-of-plane **converge at high-p_T (~10GeV/*c*)**

Outlook

PHENIX New Paper !

- **Pure geometry** plays **a larger role in energy loss** than previously thought (**arXiv0903.4886 [nucl-ex]**)
- Reaction plane dependent R_{AA} gives some **control over the path length** of the parton in the medium
- Reaction plane dependent R_{AA} provides a **more stringent test** on energy loss models

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